

A Case Study

Chart II Software Upgrade

Using a Design Competition to Procure ITS Software



Federal Highway Administration Intelligent Transportation System
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16. Abstract This is one of a series of case studies that examine procurement approaches used to deliver Intelligent Transportation System (ITS) projects. The purpose of these reports is to provide examples of successful strategies that have been used to overcome ITS procurement challenges within the traditional "Design-Bid-Build" project delivery approach. Many ITS projects are stand-alone in nature, and do not have to be procured under rules for construction. The installation of field devices and communications infrastructure often meets the definition of construction. However, if a project involves the development of software for the purpose of integrating field devices, then it does not meet this definition. The purpose of this series is to show that other procurement options are available under Federal-aid regulations for projects that do not meet the definition of construction. This case study provides an overview of the CHART II system design contract that the Maryland State Highway Administration (MDSHA) used to procure system engineering expertise necessary for the federally-funded CHART II upgrade program.					
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Procurement Options for ITS Federal-aid Projects

Definition of Construction

The term "construction" means the supervising, inspecting, actual building, and all expenses incidental to the construction or reconstruction of a highway, including locating, surveying, mapping, resurfacing, restoration and rehabilitation, acquisition of rights-of-way, relocation assistance, elimination of hazards of railway grade crossings, elimination of roadside obstacles, acquisition of replacement housing sites, acquisition and rehabilitation, relocation, and construction of replacement housing, and improvements which directly facilitate and control traffic flow, such as grade separation of intersections, widening of lanes, channelization of traffic, traffic control systems, and passenger loading and unloading areas. The term also includes capital improvements which directly facilitate an effective vehicle weight enforcement program, such as scales, and also includes costs incurred by the State in performing Federal-aid project related audits which directly benefit the Federal-aid highway program.

ITS Projects that are not Construction

Section 112 of Title 23 requires competitive bidding for all construction projects. The definition of "construction" by FHWA does not include many ITS projects. If the project is just installing field devices, it is construction. However, if the project involves software to control the devices or integration of the devices with a control center or communications system, then it is not construction. Communications systems or traveler information systems that require only limited installation are not construction. Each project should be carefully examined to determine if it falls into the construction category. Many ITS projects do not.

Prequalification of Suppliers

Even if a project does fall under construction, agencies can establish a pre-qualification process to insure that all bidders are qualified to perform the work. The criteria for qualification are defined by the procuring agency. However, if the ITS project is a part of a larger construction project, it is recommended that the ITS portion be made a separate procurement.

State Procurement Practices

If the ITS project does not fall under construction, another alternative is to use the state's own procurement procedures in accordance with 49 CFR 18. This applies to all non construction projects. Since many states have recently established special procurement rules for technology projects, this could be advantageous to implementers ITS projects.

However, if you use federal aid procurement practices, then there are other alternatives available, which are:

- *Engineering or Design Services*

This contracting mechanism can be applied to a variety of ITS projects such as software development. It has also been successfully used to retain System Integrators and System Managers that can provide the entire spectrum of services required to implement an ITS Project, such as a traffic management center. This might include the specification, procurement, configuration and installation of all hardware and software to provide the functionality required. Even if field device installation is required of the system integrator, and not done under a separate construction contract, a design - build contract could be used under FHWA SEP14.

- *SEP - 14 (Special Experimental Project number 14)*

The SEP -14 process is aimed at encouraging innovative procurement practices of all types. It has been successfully used for Design -Build and Design -Build-Operate projects. However, other value oriented procurement processes can be employed using SEP-14. To use SEP-14, permission of FHWA is required, and the contract must be awarded under some form of competitive process. However, the selection criteria may vary from project to project and generally includes: value, quality of the completed product, schedule, and cost.

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ACRONYMS

CCTV	Closed-circuit television
CHART	Chesapeake Highway Advisories Routing Traffic
COTS	Commercial off-the-shelf software
CWG	CHART Working Group
FHWA	Federal Highway Administration
ITS	Intelligent Transportation System
LAN	Local Area Network
MDSHA	Maryland State Highway Administration
SOC	Statewide Operations Center
TAR	Traveler Advisory Radio
TOC	Traffic Operation Center
VMS	Variable message sign
WAN	Wide Area Network

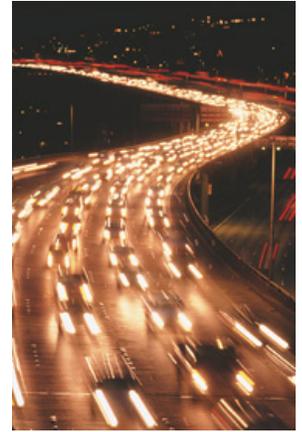
Preface

This is one of a series of case studies that examine procurement approaches used to deliver Intelligent Transportation System (ITS) projects. The purpose of these reports is to provide examples of successful strategies that have been used to overcome ITS procurement challenges within the traditional “Design-Bid-Build” project delivery approach.

Many ITS projects are stand-alone in nature, and do not have to be procured under rules for construction. The installation of field devices and communications infrastructure often meets the definition of construction. However, if a project involves the development of software for the purpose of integrating field devices, then it does not meet this definition. The purpose of this series is to show that other procurement options are available under Federal-aid regulations for projects that do not meet the definition of construction.

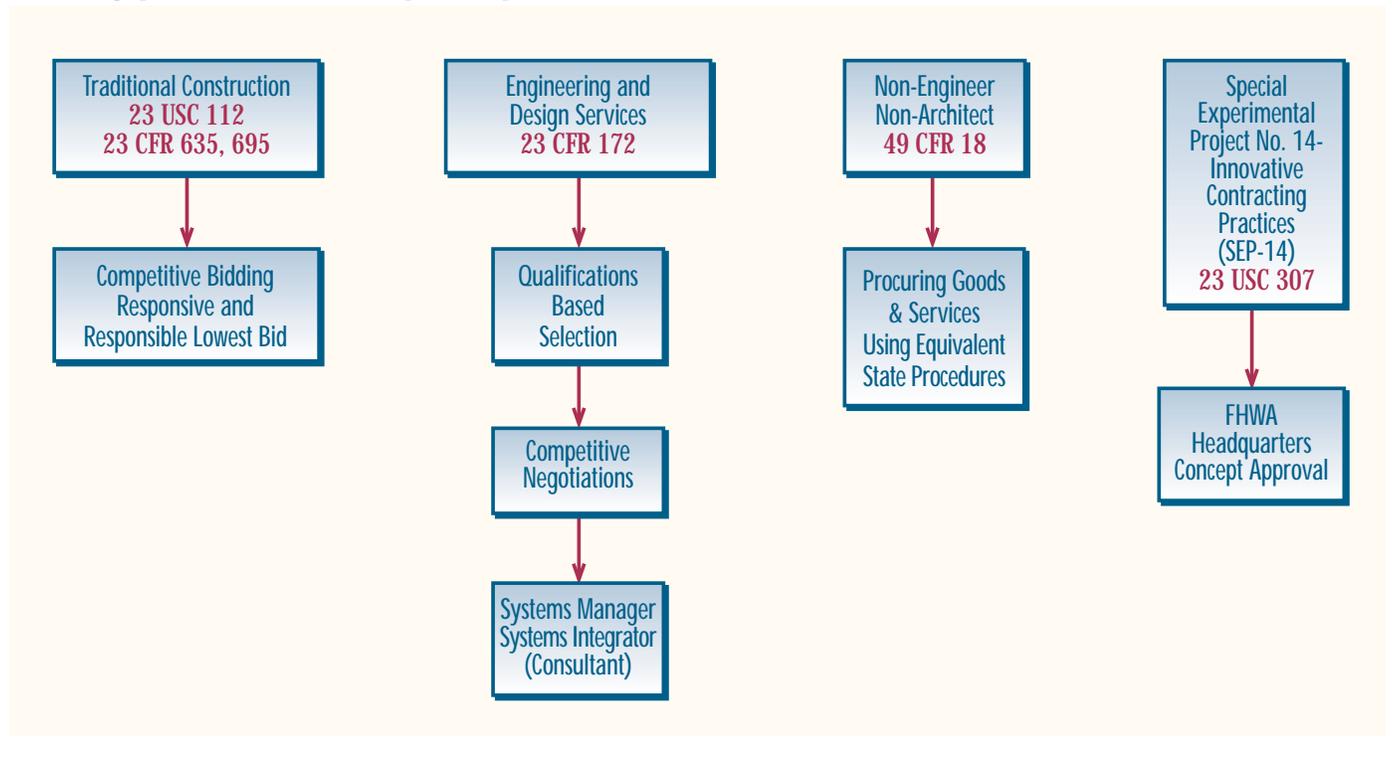
Background

The following case study provides an overview of the CHART II system design contract that the Maryland State Highway Administration (MDSHA) used to procure system engineering expertise necessary for the federally-funded CHART II upgrade program. The CHART program, started in the mid-1980s, focused on improving travel to and from Maryland’s eastern shore. Since its founding, CHART has expanded to a statewide program providing traffic monitoring, traveler information, incident management, and traffic management services for travelers throughout Maryland, including the heavily traveled Baltimore-Washington corridor.



The CHART II program is designed to significantly upgrade the current capabilities of the CHART program. At the heart of the system will be the development of enhanced and expanded software capabilities. In an effort to provide the CHART program with a maximum degree of flexibility and responsiveness in procuring the necessary services

Contracting options for Federal-aid transportation procurements





to accomplish this goal, the MDSHA conducted a design competition through an existing statewide ITS services contract. Two contractor teams were invited to participate in this competition, which resulted in preparing system requirements documentation for the CHART II program implementation. The competition, as well as the ultimate award of the implementation of the system requirements, was conducted in accord with existing Federal Highway Administration (FHWA) procurement regulations.

The Statewide Operations Center (SOC), an information clearinghouse located in Hanover near the Baltimore-Washington International airport, is the hub of the CHART system. It is supported by four satellite Traffic Operation Centers (TOCs) located near College Park, Baltimore, Rockville, and Annapolis. This hub and satellite architecture provides statewide coverage, which allows information to be distributed based on geographical needs and/or expertise, and allows operations to be managed from several different locations. To support the monitoring and control activities of the SOC and the TOCs, a large number of field components and devices are deployed, including a communications infrastructure, closed-circuit television (CCTV) system for traffic monitoring and complex interfaces to existing and new detection systems. To support the motorist information needs, the MDSHA is currently expanding its already extensive arsenal of Variable Message Signs (VMSs), Traveler Advisory Radio (TAR) transmitters, and Highway Advisory Telephone system. A media interface will also be added to the SOC system, which will allow the media to access higher quality real-time traffic video. The incident management capability will also be enhanced through the integration of all radio communications, local government communications, and our traffic signal systems activities.

The current CHART SOC represents the culmination of a four-year systems development effort that was intended to provide statewide control of VMS, TAR, and CCTV field elements. The SOC was also to have offered the capability of receiving, processing, and storing detector data and controlling various displays at the SOC and at remote workstations. Efforts to modify the current software fell short of these capabilities and the MDSHA concluded that it is unlikely these requirements could ever be achieved through



modifications to the existing software. As a result, a complete replacement of the SOC software and hardware was initiated.

The design, development, and implementation of the CHART II system required a wide variety of technical expertise, including systems engineering, software development, systems integration, and telecommunications. The MDSHA realized that it would have to procure the services of a contractor team to access this wide range of expertise. The MDSHA determined the best approach to ensuring a successful implementation of the CHART II system was to design a procurement competition using contractor teams working under the Statewide ITS Services task order contract and the Maryland Network Management Services contract.

Statewide ITS Services Contract

Several years ago, the MDSHA awarded a Statewide ITS Services Contract to five contractor teams. Under the terms of this agreement, task orders have been issued to contractor teams to provide ITS-related systems engineering and project development expertise. Under terms of the resulting agreement, task orders can be made on a sole source basis to a contractor team or could be awarded competitively at the discretion of the government.

Maryland Network Management Services Contract

The objective of the Network Management Services Contract was to provide State Agencies with an economical way to obtain Wide Area Network (WAN) and Local Area Network (LAN) services. The contract was structured as an Indefinite Delivery, Indefinite Quantity contract, allowing for the issuance of task orders for time and materials on an as-needed basis to support ITS planning and implementation. A total of two contractor teams were awarded contracts under this procurement. Earlier, both of these teams had been made awards under the Statewide ITS Services Contract. MDSHA officials were thus provided with an opportunity to conduct a design competition.

Procurement Planning

The difficulties associated with the development of the original CHART system were a result of the following problems:

- Inadequate definition of system requirements.
- A desire to use existing software that could not meet the system objectives.
- The evolution of system requirements to the point at which the system objectives exceeded the ability of the initial system to satisfy the rapidly evolving requirements.
- Inadequate staff expertise to permit the definition of system requirements.
- Inadequate communications between the system developers and the CHART staff regarding the systems capabilities.
- Flawed “low-bid” procurement method

The implemented procurement strategy was intended to avoid these problems. It featured cooperative development of systems requirements between the system integrator and MDSHA personnel. It also included an activity intended to identify future, long-term requirements in order to avoid unintended growth in the initial requirements. It was planned that the work would be done in a series of short phases, rather than a several year effort. The contractors were to deliver

a set of system requirements as the first phase before the software development began. In addition, the procurement strategy was designed to provide the system definition in adequate detail to permit MDSHA staff to evaluate the degree to which the system requirements will be satisfied by the replacement systems.

The MDSHA worked closely with the FHWA Maryland division staff to formulate a strategy for procurement of the CHART II system. This coordination ensured that the resulting contract complied with all FHWA contract requirements and was eligible for federal-aid funds.

MDSHA officials devised a procurement strategy that used an existing task order contract vehicle to conduct a design competition between two contractor teams. The specific elements comprising this strategy are described below:

- 1 A written task order was issued to two qualified contractor teams to develop a system description in adequate detail to permit the selected system integrator and MDSHA to have a through understanding of the characteristics of the system to be delivered for the CHART II software. Each contractor was provided with \$250,000 in funding and six months to complete this work.
- 2 Each contractor team was provided with all available documentation for the existing system and was encouraged to work collaboratively with CHART personnel in developing detailed system requirements. In addition, a series of independent meetings were held with CHART and contractor personnel to facilitate interaction between the contractor team and CHART staff. During these meetings, contractor personnel were encouraged to discuss various ideas and concepts with CHART personnel as well as clarify any questions they had regarding the development of the system requirements.
- 3 MDSHA established a CHART Working Group (CWG) consisting of representatives from state and local agencies who are likely to be impacted by the operation of the CHART system and who may want to cooperate. After the CWG was established, contractor teams were encouraged to attend



the CWG meetings to participate in identifying the interfaces and functions that defined the long-term expansion requirements of the CHART II system.

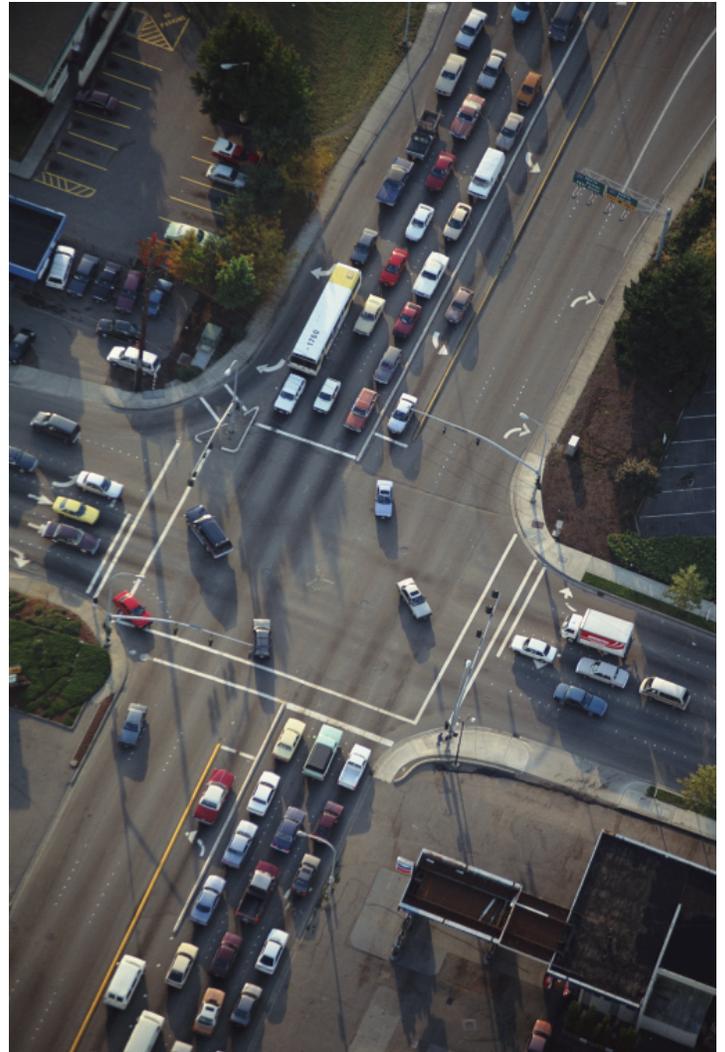
- 4 At the conclusion of the detailed system description development period, both contractor teams submitted their final products to MDSHA for final evaluation to select the contractor team most likely to provide a replacement CHART system. Following are factors considered in this evaluation:

- Responsiveness of the products produced by this task order to the requirements of the CHART replacement system.
- Quality and level of detail of the system requirements documentation.
- Applicability of the system design to the needs of the State of Maryland.
- System expandability.
- Quality of the implementation plan, including cost, schedule, and evaluation plan.
- Relevant experience and quality of the internal development processes of the proposed implementation team.

- 5 Prior to awarding a task order to the selected systems integrator, additional meetings were held between MDSHA personnel and the integrator. The purpose of these meetings was to resolve all details of the system definition to ensure that all requirements were fully defined and satisfied. A cost proposal was then submitted based on the modified system definition documentation. A follow-on task order was then issued based on the cost estimate and the modified system definition documentation.

- 6 The detailed system requirements delivered at the end of the initial period were evaluated by MDSHA. Based on this evaluation, MDSHA awarded a follow-on task order to implement the detailed system description designed by winning team. It was estimated that the value of the follow-on contract would be in the range of \$10 million.

The idea of a design competition can be very beneficial to the client. This type of procurement provides funds to support creative solutions in an effort to better determine a contractor's capabilities. A design competition can showcase the competitors' understanding of the client's needs, and allow the client to find the best partner for the project. This type of procurement also reduces the risk for both parties with respect to cost and schedule.



Scope of Services

The system requirements documentation produced as a result of the design competition task order included the following:

- A functional description of the software that fully defined all processing, displays, interfaces, and databases. Also included in this description were a discussion of the recommended architecture and a comparison of this architecture with others that have been considered.
- A prototype user's view of the system providing all information related to displays, inputs, and outputs. This view was designed to permit operators and administrators an understanding of the system operation.
- Various technical information related to life cycle requirements, estimated operations and maintenance requirements, database definition, recommended hardware, and commercial off-the-shelf (COTS) software to be used in the development and operation of the system, system security features and capabilities, and failure modes and backup capabilities.
- Description of the approach required to interface the CHART II system with existing systems operated by other agencies and the MDSHA.
- A detailed staffing plan, schedule, and budget for the work.
- An evaluation plan that defined all tests to be performed in acceptance testing.

Procurement Challenges

The development of the CHART II design competition procurement required the close cooperation among state agencies and officials of the FHWA. This interagency communication was facilitated through the involvement of the MDOT procurement staff early in the procurement process. MDOT staff worked closely with the Department of Budget and Management to ensure that the resulting contract was consistent with federal-aid procurement rules (23 U.S.C. 112; 23 CFR 172.7). The MDOT staff sought FHWA involvement in developing the Request for Proposal in order to resolve any issues that may limit the eligibility of resulting work for federal-aid reimbursement. The approval of FHWA was a



particularly important issue because the CHART II project will be heavily financed through the use of federal-aid funds. Therefore, without FHWA approval it would be very difficult to implement planned changes to the CHART system.

Contract Evaluation and Award

Contractor teams began work on the system description design immediately after the task order under the Statewide ITS Services Contract was issued. Over the succeeding six-month period, both contractor teams interacted extensively with MDSHA, CHART officials, and the CWG. This interaction was used to better define the system needs and also provide an opportunity for contractor team to understand the unique needs of the CHART II system. As required under the task order, both contractor teams delivered the required system design materials, including prototype interfaces. Following a detailed evaluation of these materials by MDSHA and CHART officials, an award was made to one of the contractor teams and a task order was issued under the Maryland Statewide Network Services Contract to begin implementing the system description.



Current Activities

Work to develop the CHART II system is well underway with Phase I deliverables on schedule for completion in the next two months. This deliverable will consist of software for the freeway management functions of the CHART II system. Over the next several years, system development will proceed incrementally with multiple phases (as recommended in software acquisition document codes) completed in turn as additional capabilities are brought on-line. In order to manage the contractor team, the MDSHA has assigned two full time staff equivalents to provide technical oversight. This provides for the necessary communication and review capabilities on the government side to ensure that the contractor staff remains on schedule and budget and that the necessary government reviews are completed. In addition, the multi-phase approach adopted for project implementation provides a clear understanding of expectations as well as flexibility in project implementation.

Benefits of the Procurement Strategy

While it may be true that the CHART II situation is unique in the sense that two contract vehicles were used to procure the system (which can be done under CFR 172.7 without having the task orders in place), it is nonetheless also true that it was completed entirely within existing federal and state procurement laws. It is, therefore, important to emphasize that the procurement strategy applied was entirely consistent with existing Federal-aid procurement regulations. The success of the approach rested on the fact that the FHWA Maryland Division office was involved throughout the process and that the MDSHA acquisition manager worked very hard to make the strategy work under Maryland law. In simple terms, it appears that persistence paid off in working the procurement effort through the necessary hurdles within existing procurement laws.

Participants in the procurement planning and acquisition process for the CHART II system cited a number of benefits to the procurement strategy pursued in this case. Included among these benefits are the following:

- The highly interactive process permitted through the design competition ensured that system designers (and ultimately system integrators) were provided with an opportunity to understand system requirements in a high level of detail. This interaction also permitted the government an opportunity to understand proposed solutions in detail. The lack of this magnitude of interaction is typically cited as a major weakness of the traditional "Design-Bid-Build" approach when applied to ITS procurements.
- The approach provided for the opportunity to see a working prototype of the proposed system. The prototypes provided a basis to evaluate the proposed system alternatives in a tangible fashion and thus gave the MDSHA a specific understanding of proposed features. Officials were in a better position to decide whether the contractor was on the right path well before a significant investment had been made in the system development and system plans could be modified.
- The process forced the government to consider alternative approaches in an informed manner. Competition was maintained but risk was reduced because the government and the contractors could collect as much information about system requirements as needed to make an informed choice.
- The contractors produced designs worth more than the initial \$500,000 government investment. The client was able to experience greater benefits because a design competition was used.

The best procurement process is not a sole guarantee of success; it is only one element. A good management style along with a team-based approach is necessary to achieve the full benefits of a particular procurement.

Procurement Resources

Documentation

- ITS Procurement Resource Guide, ITS Joint Program Office
 - FHWA Memorandum: Procurement Information for ITS Projects - *Discusses types of ITS projects and the alternatives available under federal aid.*
 - Virginia Department of Transportation Public-Private Procurement - Issues and Accomplishments *A lessons learned discussion of public- private partnerships*
 - Innovative Contracting Practices for ITS
Executive Summary & Final Report - *A detailed compendium of state and federal procurement laws and options*
 - FHWA Federal-Aid ITS Procurement Regulations and Contracting Practices
- The Road to Successful ITS Software Acquisition, ITS Joint Program Office
Executive Summary; Vol. I; Overview and Themes; Vol. II; Software Acquisition Process Reference Guide - *A discussion of the key issues and approaches to responding to those issues.*
- ITS Software: Effective Acquisition Practices, NCHRP - *This report will be available from AASHTO by the end of the year.*
- Successful ITS Procurement Case Studies (*Available 1/1/2000*)
(All DOT documents available via the ITS web site www.its.dot.gov)

Training (See NHI course listing)

- ITS Software Acquisition; *A two day course for project managers and engineers based upon "The Road to Successful Software Acquisition".*
- ITS Procurement Using Federal Aid; (*Available 1/1/2000*) *This one day workshop, aimed at project managers and procurement officials, will concentrate on the use of various contracting approaches allowed by federal aid for ITS projects.*

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